

Letter to the Editor

Responses of incubating females to female cuckoo calls in 2 hole-nesting bird species**Chao SHEN^{a,b}, Jiangping YU^{a,c}, Xudong LI^{a,b}, Jing YUE^a, Haitao WANG^{a,*}, and Wei LIANG^{d,*}**

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Acoustic signals play an important role in animal communication systems, and these signals can transfer diverse and meaningful information from a signaler to a receiver (e.g., Yu et al. 2019). Animal signals tend to be honest; however, deception can occur when it is beneficial for receivers to send dishonest signals, such as by mimicking alarm calls to steal food from other individuals (Flower et al. 2014). In birds, vocal mimicry is a widespread phenomenon that has 2 major functional explanation categories: intraspecific and interspecific communications (Dalziell et al. 2015). Vocal mimicry in intraspecific communication mainly involves sexual selection and social affiliation (Dalziell et al. 2015). In interspecific communication, studies on vocal mimicry are mostly related to predator–prey interactions (Dalziell et al. 2015). Mimics could mimic calls of predators to scare off other predators or competitors. For example, some species of hole-nesting birds produce a snake-like hissing call to drive nest predators away (e.g., Dutour et al. 2020). Receiver should be particularly sensitive to the deceptive vocals of mimics if failing to respond to an actual model sound is costly. Therefore, the mimics could derive an advantage from mimicking the calls of predators of the receivers. A recent experimental study suggested that the bubbling calls of female common cuckoo *Cuculus canorus* mimic those of Eurasian sparrowhawk *Accipiter nisus*, and they primarily serve to distract regular hosts after laying eggs (York and Davies 2017). However, Xia et al. (2019) found that female cuckoo calls have other functions, including attracting mates and repelling rivals.

Hole-nesting species, such as cinereous tits *Parus cinereus* and yellow-rumped flycatchers *Ficedula zanthopygia*, are sympatric during the breeding period in the Zuojia Nature Reserve of China. This population of cinereous tits showed a 70% egg-rejection rate (Liang et al. 2016), implying that they may be currently parasitized or have historically interacted with parasites. However, yellow-rumped flycatchers generally do not reject foreign eggs (W. Liang et al. unpublished data) and have not been recorded as hosts for various cuckoo species. York and Davies (2017) suggested that the acoustic characteristics of female cuckoo calls are similar to those of sparrowhawk calls and the 2 calls could elicit vigilance behavior in regular hosts and noncuckoo hosts. In this study, we played another sparrowhawk calls types (see Supplementary Figure S1) and female cuckoo calls for cinereous tits and yellow-rumped flycatchers to test whether the functions of female cuckoo calls and sparrowhawk calls are similar. We hypothesized that 1) if the function of the 2 calls is similar, then the 2 bird species should exhibit similar behavior to female cuckoo and sparrowhawk calls; and 2) if the function of the 2 calls is different, then the 2 bird species should exhibit different behavior to female cuckoo calls and sparrowhawk calls.

Playback experiments for 27 incubating yellow-rumped flycatchers and 17 incubating cinereous tits were conducted during the incubation period (April–May for tits and May–June for flycatchers) in 2017 and 2020, respectively. Calls of female cuckoo, male cuckoo, Eurasian sparrowhawk, and Oriental turtle dove *Streptopelia orientalis* (neutral control) were used to study the effect of the 4 call types

on the antipredator behavior of 2 hole-nesting birds species. Before the experiments started, it was confirmed that the females were incubating and inside the nest, and then the researchers conducted 30 s playback experiments. We scored the playback response of tits and flycatchers during 30 s of observation and used a generalized linear mixed model to analyze the difference in response scores of the 2 birds species to the 4 types of calls (detailed methods are described in the [Supplementary Materials](#)). In the playback experiment for cinereous tits, the playback response scores varied significantly across the 4 types of calls (GLMMs, $\chi^2_3 = 11.226$; $P = 0.01$; $n = 17$). The playback response score to sparrowhawk calls was greater than that to dove calls or male cuckoo calls ([Figure 1](#); [Supplementary Table S1](#)). Similarly, the playback response score to female cuckoo calls was greater than that to dove calls or male cuckoo calls ([Figure 1](#); [Supplementary Table S1](#)). However, significant differences in the playback response scores were not observed between the female cuckoo calls and sparrowhawk calls or between the male cuckoo calls and dove calls ([Figure 1](#); [Supplementary Table S1](#)). For yellow-rumped flycatchers, significant differences in the playback response scores were not observed to the 4 types of calls (GLMMs, $\chi^2_3 = 5.747$; $P = 0.14$; $n = 27$; [Figure 2](#)).

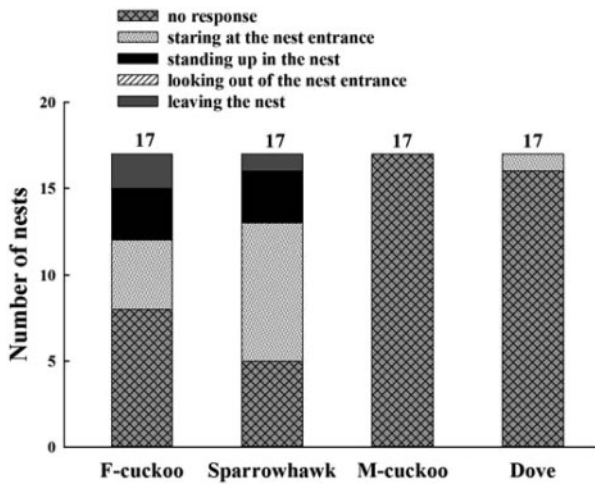


Figure 1. Responses of cinereous tit to calls of female cuckoo, sparrowhawk, dove, and male cuckoo.

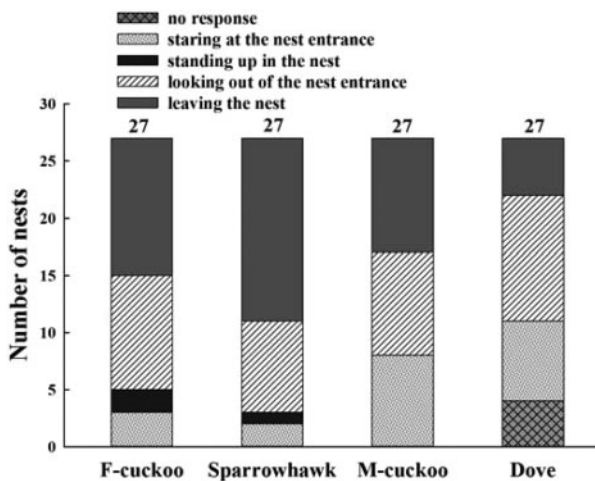


Figure 2. Responses of yellow-rumped flycatcher to calls of female cuckoo, sparrowhawk, dove, and male cuckoo.

Our results indicated that the 2 hole-nesting birds adopt different antipredator strategies when confronted with 4 types of calls. Most female cinereous tits stared at the entrance or had no response in the nest box and did not leave the nest when hearing the 4 types of calls ([Figure 1](#)). Small entrances could prevent large species (e.g., nest predators and raptors) from entering hole nests. Therefore, incubating female tits may not be required to escape from the nest box when hearing the 4 types of calls. However, sparrowhawk calls still represent a threat for adults of cinereous tits, and more than half of female tits exhibited vigilance behavior in the nest after the sparrowhawk calls; however, almost all individuals did not respond to the innocuous calls of the dove and male common cuckoo ([Figure 1](#)). In addition, female tits responded similarly to female cuckoo calls and sparrowhawk calls, suggesting that the population of tits in our study area cannot differentiate the “sparrowhawk-like” calls of female cuckoo and regard them with the same level of risk as the sparrowhawk calls. Similar results were found in the studies of [York and Davies \(2017\)](#). To the human ear, the female common cuckoo call is quite different from the sparrowhawk call; thus, why are female tits deceived by this imperfect vocal mimicry? Previous studies found that superb fairy-wrens *Malurus cyaneus* respond strongly to relatively dissimilar unfamiliar calls because the frequency of these calls resembles that of a sympatric species call, which suggests that some similar acoustic characteristics can promote responses to unfamiliar heterospecific calls ([Fallow et al. 2011](#)). Hence, the similar acoustic features, including the fundamental frequency and rate, between female cuckoo calls and sparrowhawk calls ([York and Davies 2017](#)) may be sufficient to trick female tits and generate a response to the female cuckoo “sparrowhawk-like” calls. Vocal mimicry among heterospecific species generally occurs in the context of predation pressure ([Dalziel et al. 2015](#)), and the receivers will tend to avoid the truly threatening model and the mimics that they identify as presenting the same level of risk. Therefore, female cuckoos derive an advantage from mimicking sparrowhawk calls. However, most female yellow-rumped flycatchers stepped onto the nest entrance and left the nest box in response to 4 types of calls ([Figure 2](#)). Yellow-rumped flycatchers are very prudent, and they may not assess the risk accurately just by auditory cues. Stepping onto the nest entrance and leaving the nest-box could help them gather information on the locations of potential invaders based on both visual cues and auditory cues ([Suzuki 2015](#)). The results of female yellow-rumped flycatchers are consistent with the theoretical predictions of predation risk assessments because female flycatchers generally overestimate the potential risk of increasing the information level and minimizing the risk of being injured or killed ([Bouskila and Blumstein 1992](#)). In conclusion, our results showed that 2 sympatric hole-nesting birds adopt different antipredator strategies. Cinereous tits cannot discriminate female common cuckoo from sparrowhawk calls, which further verifies the effectiveness of female common cuckoos mimicking sparrowhawk calls. However, whether yellow-rumped flycatchers recognize the “sparrowhawk-like” female cuckoo requires further investigation.

Ethical Standards

The experiments comply with the current laws of China. Fieldwork was carried out under the permission from Zuojia Nature Reserve. Experimental procedures were permitted by National Animal Research Authority in Northeast Normal University (approval number: NENU-20080416).

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Authors' Contributions

H.W. and W.L. conceived and designed this study. C.S., X.L., and J.Yue. carried out field experiments. J.Yu and C.S. performed data analyses. C.S. and J.Yu. drafted the manuscript, and W.L. and H.W. involved in discussion and revised the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

We declare that all authors have no competing interest.

Supplementary Material

Supplementary material can be found at <https://academic.oup.com/cz>.

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